CHAPTER 6

CRUSHER SUPERVISOR

Equipment is provided by the Naval Construction Force (NCF) to enable the Seabees to meet aggregate production requirements. Of this equipment, crushing equipment is the critical item that provides the capability to reduce and process material from a *pit* or *quarry* to produce finished aggregate in sufficient quality and quantity to meet construction requirements.

Seabees are tasked with crusher operations in both Pacific and Atlantic fleet deployment sites. The Naval Construction Training Center (NCTC), Port Hueneme, California, provides training for crusher operations; however, the majority of training in this area is achieved through on-the-job-training (OJT).

The *COMSECOND/COMTHlRDNCB* direct the tasking of crusher operations conducted by the Naval Mobile Construction Battalions (NMCBs). The NMCBs schedule a predetermined number of man-days for crushing a variety of sizes and volumes of material used to support construction projects, concrete plants, crete mobiles, and asphalt plants. At the end of a deployment, each battalion involved is usually tasked to turn over a specified number of cubic yards of material of various sizes to the relieving battalion. The magnitude of the rock crusher tasking dictates the size of the crew assigned to support the rock crusher operations.

CRUSHER SUPERVISOR RESPONSIBILITIES

In the Naval Construction Force (NCF), crusher operations are usually managed by Alfa company. The Alfa company operations chief is responsible for crusher operations and should assign a crusher supervisor to direct the operations of the crusher. This chapter presents important information an EO must master to gain the basic knowledge of rock crusher operations required to perform the duties of a crusher supervisor.

ROCK CRUSHER

Crushing plants are classified by their capacity output. The most often used plant, classified medium-to-large, has a rated capacity of 75 tons per hour (tph). This plant has two separate and distinct sets of equipment: the primary unit and secondary unit.

The primary unit reduces the quarry rock or coarse gravel by crushing. The secondary unit is primarily used to process the crushed product.

The amount of crushing required to produce a suitable amount of aggregate material depends upon the availability of raw materials and the specifications established for the end product. In any crusher operations, there are four basic functions that have to be accomplished. The four functions are as follows:

1. Particle size reduction by crushing.
2. Separation into particle size ranges by screening.
3. Elimination of undesirable materials by wushing.
4. Movement of the material from one location to another.

Primary Unit

The primary unit (fig. 6-1) consists of a 20-inch by 36-inch standard type of jaw crusher (fig. 6-2), a vibrating grizzly, an under crusher delivery conveyor, and a running gear. The jaw crusher can be powered by a diesel engine or by electrical power. All other components are driven by individual electric motors. Normally, power is supplied by a 200-kW diesel generator. The running gear is equipped with a fifth wheel and towing dolly.

CAUTION

Make certain each electrically powered component is grounded.

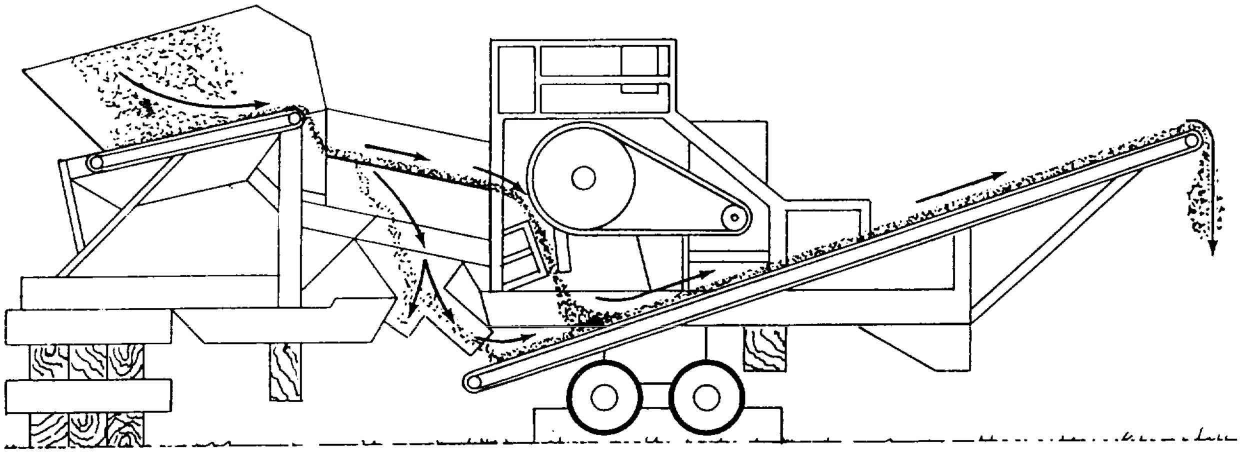


Figure 6-1.-Primary unit.

Most crusher and screening units plants are equipped with some type of feeder to regulate the flow of material into the crusher unit. A heavy-duty apron type of feeder (fig. 6-3) is usually used to feed the primary crusher. Raw materials from the pit or quarry are deposited into the hopper of the heavy-duty apron feeder that moves the material onto the deck of the vibrating grizzly. The rate of flow of the feeder belt is controlled by the operator using the **START** and **STOP** buttons located on the control panel.

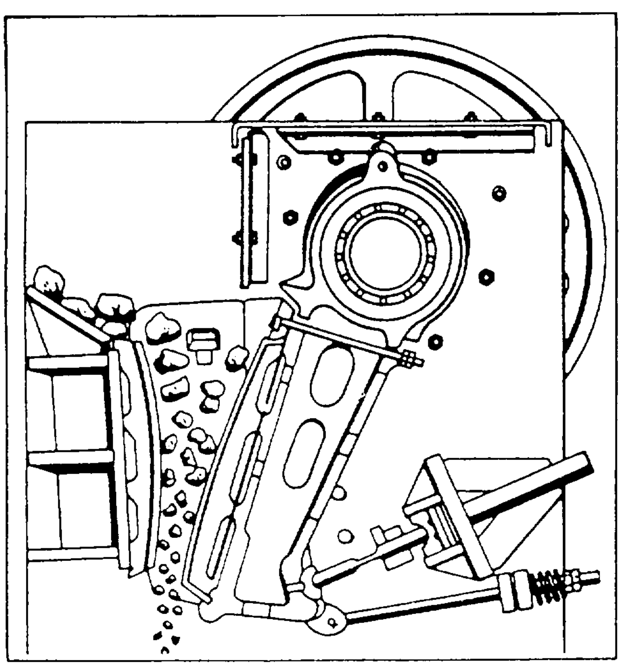


Figure 6-2.-Jaw crusher.

As material is moved out of the apron feeder, it is processed across the vibrating grizzly. The deck is normally a bar type of screen with a 1 1/2-inch fixed opening. It screens out material smaller than 1 1/2 inches and routes the oversized material through the jaw chamber to be crushed. The undersized material is routed through a chute to the undercrusher conveyer. From this point the material can join the jaw crusher product by closing a flop gate. This material can be directed through another chute (by closing a flop gate) and routed to a by-product stockpile.

The vibrating grizzly prescreens material that is already down to size, allowing the material to bypass the jaw crusher. The grizzly also dry-cleans the material by vibrating it vigorously. The flop gates on the grizzly enable the operator to select and decide what to do with smaller particles.

Oversized material is routed through the jaw crusher where it is gradually reduced in size by a series of elliptical- downward crushing strokes and is then discharged onto the undercrusher delivery conveyer belt. The product size is determined by the product setting adjustment made at the discharge end of the jaw plates.

The hourly rate of production to be obtained from a given size jaw crusher depends upon a number of variable factors:

1. The toughness of the raw material.
2. The product setting.
3. The reduction ratio. (The size of the material fed to the crusher compared to the product size.)

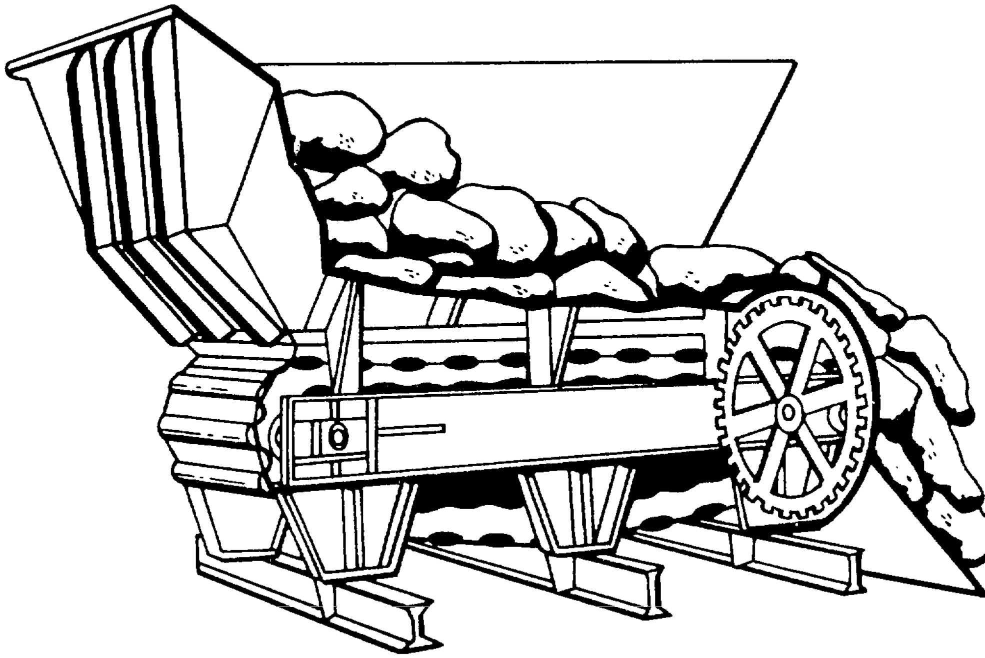


Figure 6-3.-Apron feeder.

4. The gradation of raw material.

5. The extent of wear to the corrugated surfaces of the jaw plates.

6. The rate of feeding.

Feeding problems may develop due to irregular shapes and unwieldy nature of quarry run rock. Feeding problems can drastically reduce production. Some common problems are blocking, bridging, choking, and packing.

Blocking occurs when an oversize rock settles over the jaw opening and stops the flow of incoming material. The jaw continues to operate but no crushing takes place. To prevent blocking, you should let the maximum size of material processed be 2 inches less than the jaw crusher size. Blocking can be controlled or eliminated by using a scalping grizzly to prescreen material. *For optimum production, the ideal feed size is 75 percent of the jaw size.*

Bridging occurs when two rocks, within the maximum size, arrive at the same time. The two rocks interlock and bridge the jaws open. When this occurs, all production stops. When large rocks approach the opening, they should be fed individually to prevent bridging.

Choking occurs when the jaw chamber is continually overfilled. This creates an overload condition and causes the engine to lug down and may damage the equipment. For optimum production, the operator should try to keep the jaw chamber 75 percent full.

Packing occurs when feed material cakes and packs in the crusher chamber. Plastic material, such as clay, may become sticky and cause this problem. Packing can become so severe that it completely stops production. Packing can be reduced or eliminated by prescreening or prewashing the material. In most cases, the most practical solution is to wet down the material thoroughly. Then process the material even though it is almost in the form of a slurry.

The jaw crusher can produce at a rate of 55 to 185 tph, depending upon the product setting and the toughness of the material being crushed. The maximum product setting is 5 inches, and the minimum setting is 1 1/2 inches.

WARNING

Keep all parts of your body out of the jaw cavity when you are operating or adjusting the jaws.

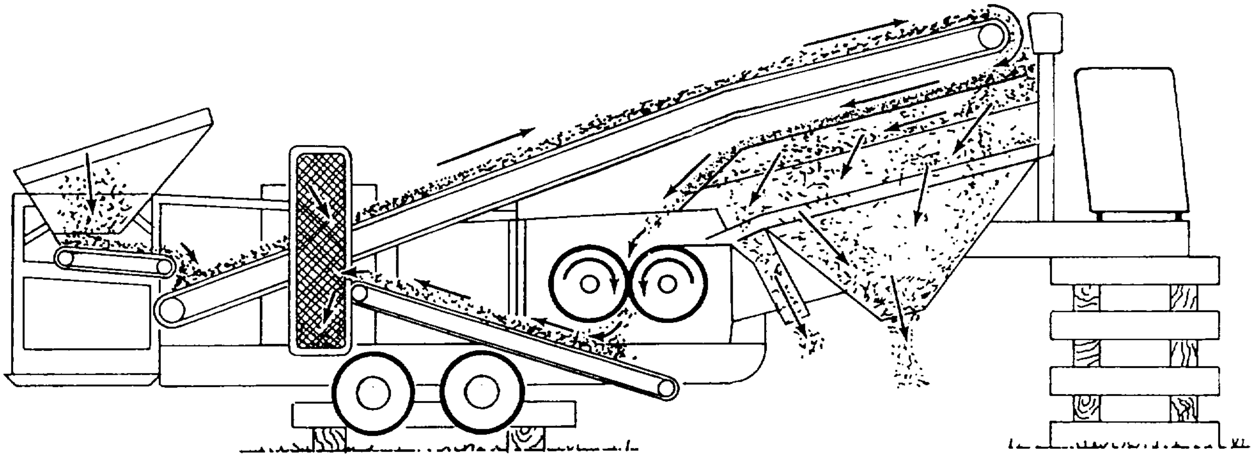


Figure 6-4.-Secondary unit.

Secondary Unit

The secondary unit (fig. 6-4) consists of a reciprocating feed hopper, an overcrusher conveyer, a two-deck vibrating screen, a *dual roll crusher* (fig. 6-5) or *hydrocone* crusher (fig. 6-6), an undercrusher return conveyer, a revolving elevator wheel, a diesel power unit, and the running gear. The dual roll or hydrocone crusher can be driven by a diesel engine or an electric motor. All other components are driven by individual electric motors and power is normally supplied by a 200-kW generator.

Material to be processed is introduced into the hopper of the reciprocating feeder. The rate of flow is controlled by the adjustable gate opening. Material is deposited onto the overcrusher conveyer and carried to the feed end of the top screen. Material that has been crushed down to product size by the jaw crusher passes the top screen. Oversized material is retained on the top screen and directed through a *dual roll crusher* or *hydroccme crusher* for further reduction.

The *dual roll crusher* consists of a set of rolls that revolve toward each other at a constant rim speed. Stone particles are reduced in size as they are drawn between the two rolls. Product setting is determined by the

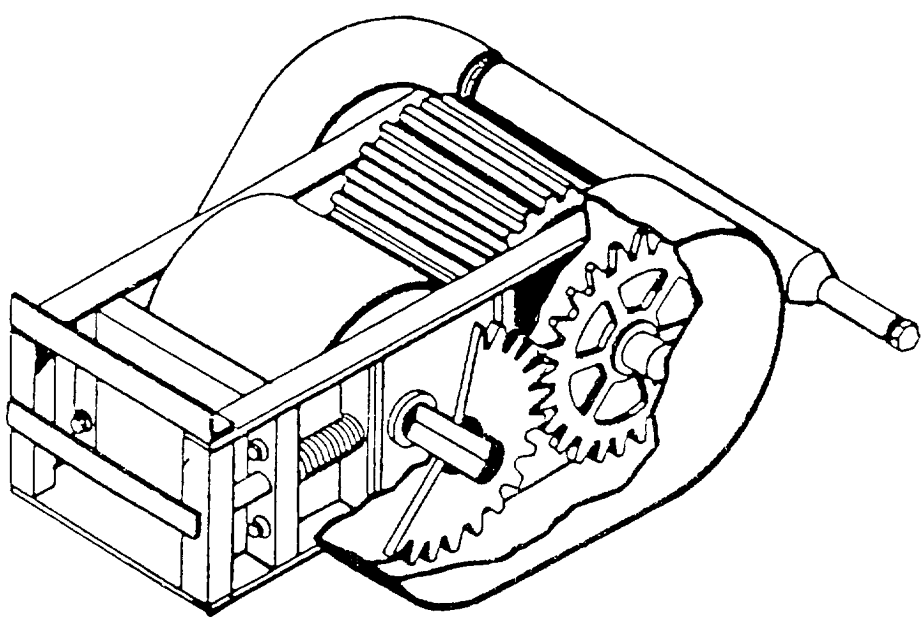
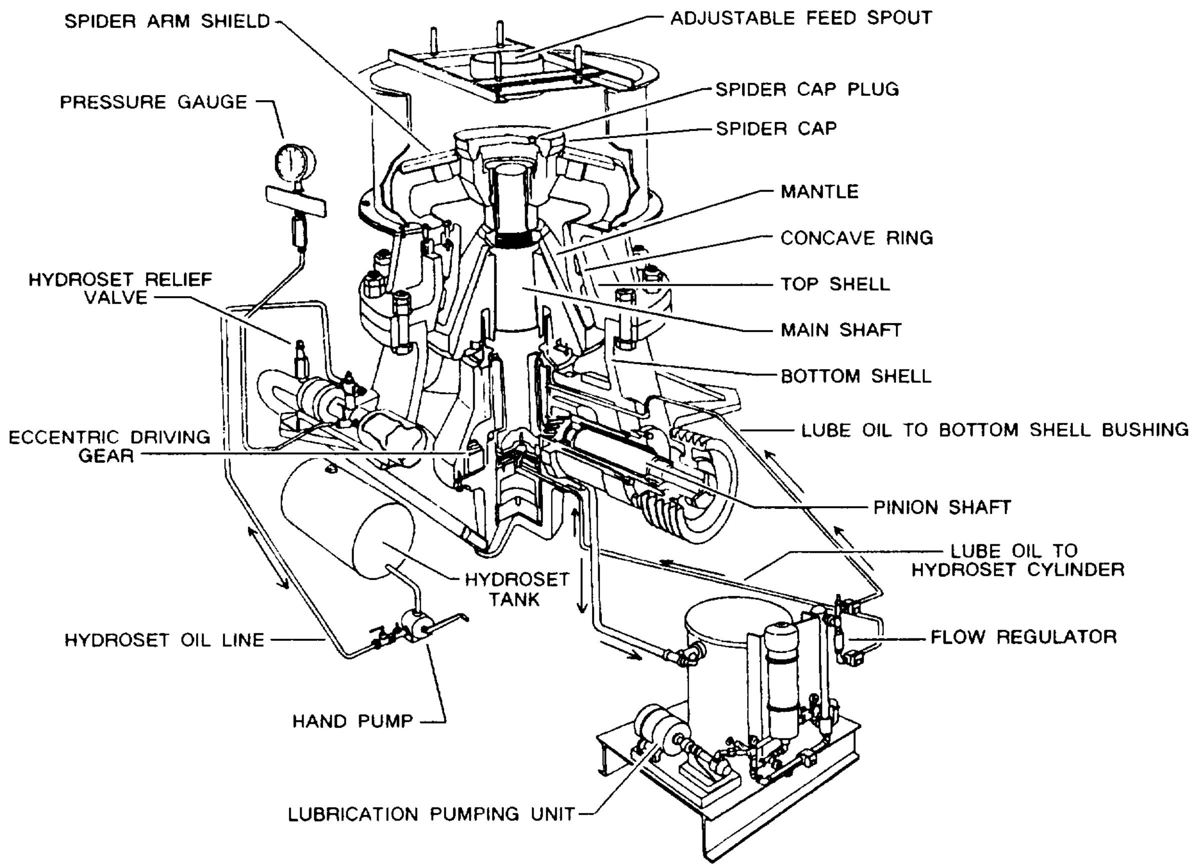


Figure 6-5.-Dual roll crusher.



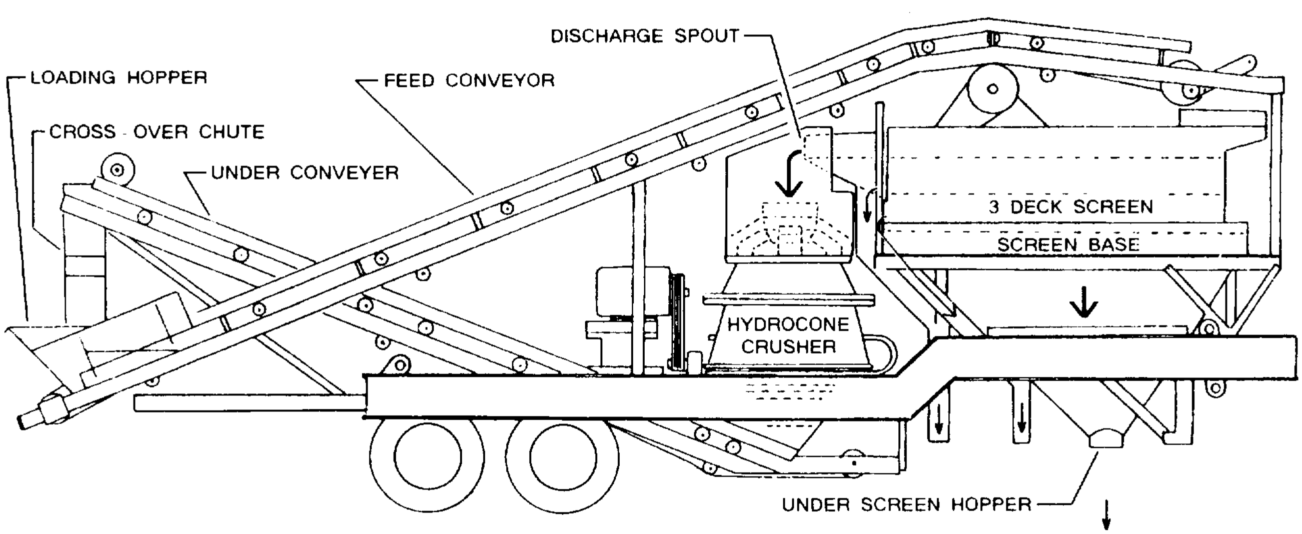


Figure 6-6.-Cone crusher plant.

spacing between the rolls. It is necessary to set the opening between the rolls slightly closer than the top product size required. With two coarse corrugated shells (fig. 6-7), the tip-to-tip setting produces a product larger than two smooth shells set at the same distance.

In the NCF, the *hydrocone crusher* is normally used as the secondary unit. These machines have a conical or domed crushing member called a cone, head, or sphere, which moves in a small circle around a vertical axis inside a fixed bowl or mantle.

The cone may be relatively stationary at the top and move at the bottom only, or be mounted so that the head can wobble as well as gyrate. The crushing head is free to turn under the thrust from the material being crushed. The fineness of the product is adjusted by raising or lowering the mantle.

Effective feed and discharge arrangements are essential to the operation of any cone type of crusher. For maximum crushing efficiency, feed must be supplied to the crushing chamber in the optimum amount and distributed evenly around the entire crushing area.

NOTE: Material received by the *hydrocone crusher* must be evenly distributed nonsegregated feed. This means that the material entering the crusher is evenly distributed around the entire crushing chamber, with fine and coarse material well intermixed in the feed. Unevenly distributed or segregated feed results in poor manganese wear, reduced capacity, and high stresses within the crusher. These problems can cause short bearing life and possible failure of major components. An evenly distributed, nonsegregated feed results in maximum capacity, a uniform product, and a smooth running machine.

A pressure gauge is standard on all *hydrocone crushers.* Erratic hydroset control pressure and motor amperage (horse-power draw) readings are evidence of poor feeding conditions and uneven feed distribution in the crushing chamber. The pressure gauge enables the operator to read high, average, and low pressures in the hydroset control and take corrective measures against erratic and high-pressure conditions. The pressure gauge should be checked regularly when the crusher is receiving the full or maximum amount of feed.

NOTE: When excessive fluctuations occur in the pressure in the hydroset control and horsepower drew, determine and eliminate the cause immediately. Operating the crusher under these conditions can cause

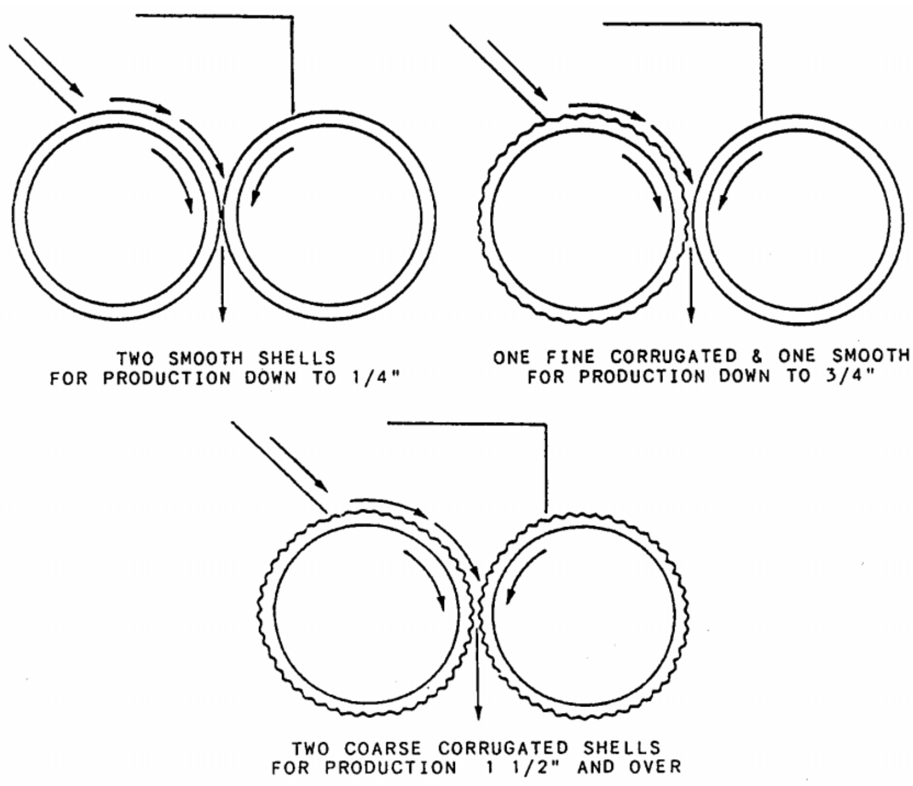


Figure 6-7.—Shell combinations for dual roll crushers.

excessive shock loading and may result in serious damage to the crusher.

All *hydrocone crushers* are supplied with a feed hopper with an adjustable feed spout that is adjustable both vertically and horizontally. Horizontal adjustment of the spout is accomplished by moving the adjustable feed spout frame on the feed hopper. Slotted holes in the upper flange of the feed hopper, and in the feed spout frame, allow the feed spout to be moved horizontally in order to position it properly over the feeder plate or spider cap. The feed spout can be positioned vertically by using studs and adjusting nuts to fasten the spout to the frame. The vertical position of the spout controls the amount of feed going into the *hydrocone crusher.*

Adjustable feed spout frame construction allows the mounting of a suitable feedbox. Normally, it is better to have the incoming feed hit the side of the feedbox, after which it falls vertically through the feed spout. This is the most effective way of obtaining proper feed to the *hydrocone crusher* (fig. 6-8).

The discharge arrangement setup must allow the material to discharge freely without backing up underneath the crusher. Material backing up below and into the *hydrocone crusher* can result in serious damage to the machine.

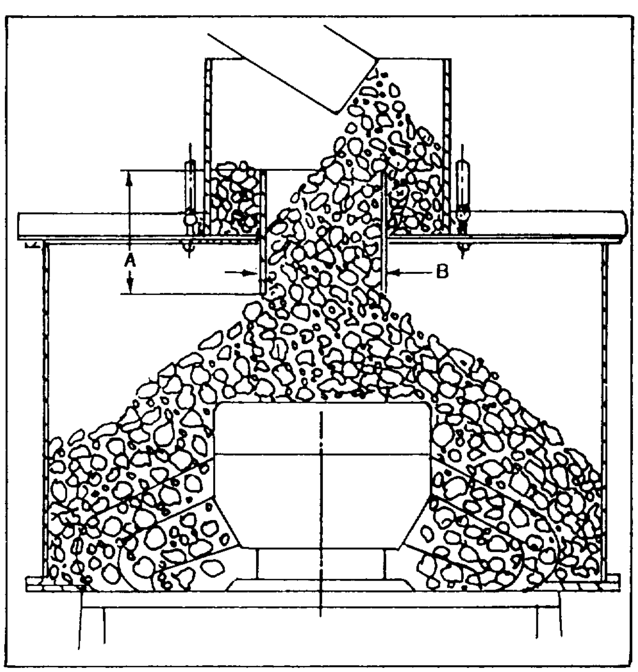
A straight-down discharge is commonly used with *hydrocone crushers.* With this arrangement, crushed material falls into a stone box below the crusher. Material passes through a hole in the stone box floor onto a conveyer belt that carries it away. This discharge arrangement helps prevent buildup of sticky materials beneath the crusher.

The crushing chamber is annular (ring shaped). Rock fed into the top falls between the cone and the mantle and is crushed as the opening narrows with the movement of the cone. When the opening widens again, the pieces fall farther, to be crushed again as the cone gyrates. The crushing action is similar to that of a jaw crusher, except the squeeze comes from the side rather than from the bottom and the curve of the jaws.

The cone speed and the distance of travel must be carefully synchronized. A wide space allows pieces to fall more freely than a narrow one when the cone is moving slowly; however, it allows pieces to fall too far before the next impact. On the other hand, where the space is narrow and the cone is moving rapidly, the pieces cannot fall far enough and this causes production to be low for the amount of power being used.

CAUTION

DO NOT operate the *cone crusher* at a smaller setting than that for which it was designed. Operation at too small a discharge



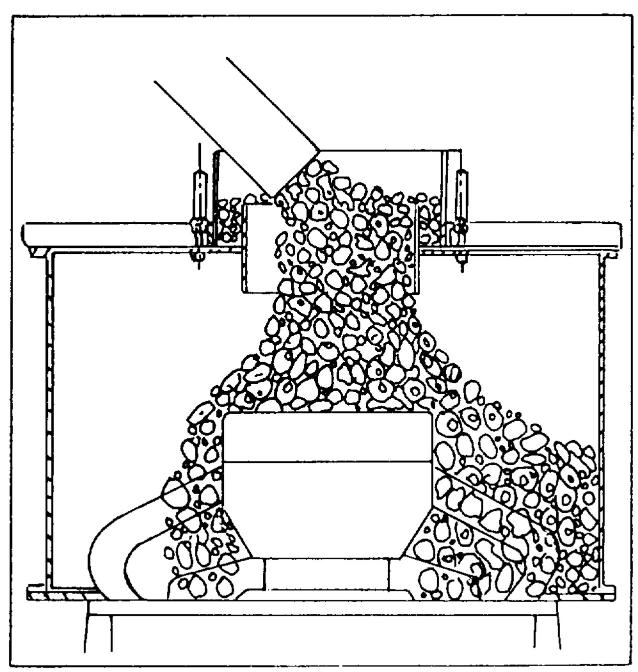


Figure 6-8.-Recommended cone crusher feed arrangement.

setting may result in packing in the crusher chamber, high loads and stresses, and possible damage to major components.

After passing the *dual roll crusher,* the material is recirculated to the top screen by means of a return conveyer and a revolving elevator wheel. The material from the *hydrocone crusher* is recirculated to the top screen by means of a return conveyer and a crossover chute. Any material still too large to pass the top screen is routed through the *roll crusher* or *hydrocone crusher* again. This is known as a "closed circuit" crushing system. It is obvious that the product setting on the *roll crusher* or *hydrocone crusher* should be set at or slightly less than the opening size of the top screen.

The material retained on the bottom screen is the product that is routed through a chute to a conveyer and then delivered to the product stockpile. Material too small to meet product specifications is screened out by the bottom screen and delivered to a by-product stockpile.

The secondary unit includes a bar type of scalping screen that can be inserted into the top rim of the sloping hopper. When inserted, this screen causes any oversized material to be scalped and rolled off of the screen and to the rear of the machine.

The same factors discussed for the jaw crusher also affect the production of the roll crusher. By comparison, *dual roll crushers* have a limited "stage of reduction" capability. *"Stage of reduction" is the difference, expressed in inches or centimeters, between the maximum input and maximum output size of material due to a single crushing action.* A stage of reduction of 3 inches (7.6 cm) indicates a 3-inch (7.6-cm) reduction in maximum particle size. This reduction capability is a function of the diameter of the rolls and of the nature of the roll shell surface; therefore, every different size and combination of roll shells has a somewhat different stage of reduction capacity. For this reason the maximum size of material to be fed to a *dual roll crusher* is critical.

The maximum allowable feed size is the sum of the stage of reduction capability and the product setting. If the maximum feed size is exceeded, unsatisfactory results likely to occur are as follows:

1. Retarded production
2. Excessive roll shell wear
3. Excessive long-and-flat particles

These units also have a wide range of production capability. The actual rate of production in tons per hour is usually determined by the screening capacity of the screens. In some cases, the rate may be limited by the capacity of the *dual roll crusher* or *hydrocone crusher.*

Screens

Crushed rock particles are separated into two or more particle size ranges by the use of screens (fig. 6-9). Screens are also used to scalp off oversized rock and to

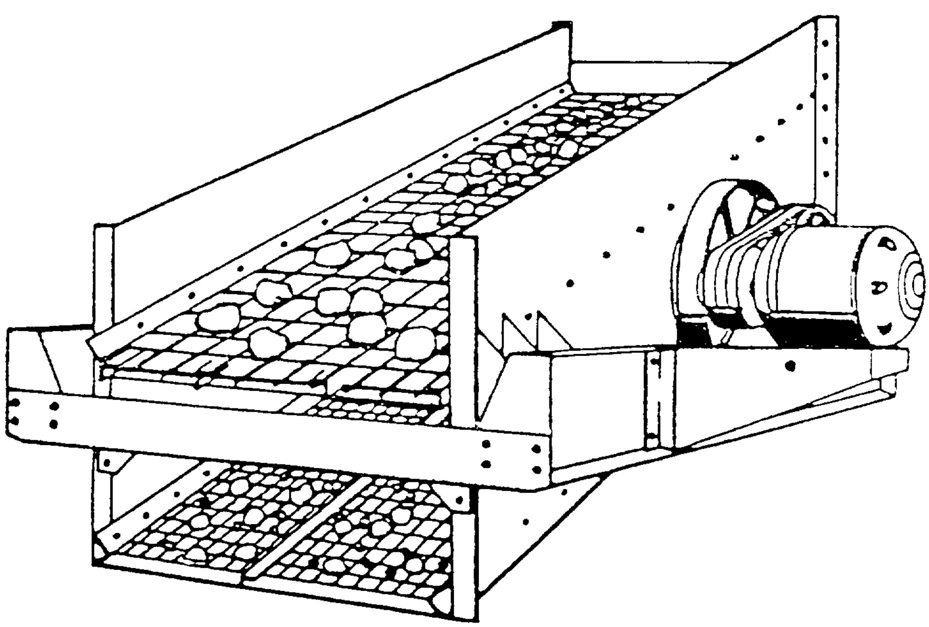


Figure 6-9.-Vibrating screen box.

screen out fines. This enables you to direct certain selected material to receive special or additional processing. Certain material may also be directed to bypass processing that is not required.

Screens consist of two, three, or four layers or decks of open-mesh screen wire cloth, mounted one above the other in a rectangular metal box. The screen surfaces are vibrated to aid sorting. Material is fed at one end and is separated into size ranges as it passes over the screening surface. The screening process is based upon the fact that particle sizes smaller than the screen cloth opening size passes through the screen and oversized particles are retained.

Stratification of the feed material must occur rapidly as the material is passed over the screen surface to obtain good efficiency and high capacity. This ensures the smaller particles can move quickly to the bottom and fall through the screen openings, and the larger oversized particles are carried to the top of the feed stream where they are retained and directed off the end of the screen. The desired performance of specific screens is obtained by varying the *degree of inclination, frequency and amplitude of stroke,* and the *direction of throw.* Screens may be horizontal or inclined up to about 20 degrees and vibrate at 850 to 1,250 strokes per minute, depending upon the particular application.

CAPACITY.– Capacity is the rate in tons per hour at which a screen produces (passes) the material desired. The capacity of a screen is the rate at which it separates desired material from the feed.

FEEDING MATERIALS TO SCREEN.– Care must be taken to spread the flow of material evenly across the full width of the screen. *The thickness of the bed of feed material should be approximately four times the screen opening size.* If this is exceeded, the screen becomes overloaded and the vibrations are dampened. This results in the finer particles being unable to find their way to the screen wire opening. When an insufficient amount of material is fed, the total capacity of the screen is not used.

VARIABLE FACTORS.– Numerous factors can affect the performance of screens. Some examples of these are as follows: shapes, weight, and gradation of particles; degree of inclination and vibration; type of wire screen cloth; position of the screen within the deck; and wet screening (washing).

Screen Selection

Once the gradation of material has been determined, screens must be selected that can segregate the materials into appropriate sizes. The number of screens to be selected is dependent upon the number of size ranges into which the material must be segregated and the type of equipment available for screening. Table 6-1 gives the screen sizes of vibrating screens used to produce specific sizes of aggregate.

Table 61.-Vibrating Screen Selection Chart

Product size	*Required screen size*
No. 8	No. 4
No. 6	3/16"
No. 4	1/4"
1/4"	5/16"
5/16"	3/8"
3/8"	7/16"
7/16"	1/2"
1/2"	5/8"
11/16"	3/4"
3/4"	7/8"
7/8"	1"
1"	1-1/8"
1-1/8"	1-1/4"
1-1/4"	1-3/8"
1-3/8"	1-1/2"
1-1/2"	1-3/4"
1-3/4"	2"
2"	2-1/4"
2-1/4"	2-1/2"
2-1/2"	2-3/4"
2-3/4"	3"
3"	3-1/2"
3-1/2"	4"

The selection of screen sizes depends upon the size of the product desired. The maximum and minimum sizes of the product are expressed in the specifications. Consider the following specifications:

Size	Percent Passing
1 inch	100 percent
3/4 inch	90 to 100 percent
1/2 inch	20 to 50 percent
3/8 inch	0 to 15 percent
No. 4	0 to 5 percent

By this specification, the largest size aggregate that is acceptable is 1 inch. Since 100 percent must pass through the screen for 1-inch aggregate, 0 percent can be larger than 1 inch. Although the specification says that the lot is acceptable with up to 5 percent of the total product passing through a No. 4 sieve, it is saying that the No. 4 aggregate is the smallest size desired.

Based on these specifications, the plant should be calibrated to produce a product between 3/4 and 3/8 inches. The reasoning behind calibrating the plant to produce a 3/4-inch to 3/8-inch aggregate rather than a 1-inch to No. 4-size aggregate is because somewhat oversize particles can pass a given screen opening size when oriented diagonally.

By calibrating the plant to produce a top size of 3/4-inch aggregate, you can provide a safety margin of 10 percent in the event the product stockpile may contain aggregate over 3/4 inch, but less than 1 inch. The same reasoning holds true on the minimum product size. Calibrate the plant to produce 3/8-inch aggregate as the minimum size, thereby creating a 15-percent leeway for particles in the stockpile being less than 3/8 inch. Therefore, *you should choose the next smaller size screen than the given maximum specification size for the upper size calibration. Smiliarly, you should choose the next larger size screen than the given minimum specification size for the lower size calibration.*

Remember: It is necessary to select screens with openings slightly larger than the size products desired. This is due to screen inefficiency caused by the tingle of inclination, throw, and angular particle shapes.

Table 6-1 is used for the selection of screens and the relationship between product size and screen size. For example:

If your plant has a two-deck vibrating screen, you should select the following screens:

Product Size Desired	Screen Size Selected
Top 3/4 inch	7/8 inch
Bottom 3/8 inch	7/16 inch

The relationship between aggregate size and screen size is important. The required screen sizes are slightly larger than the product sizes. If a 7/8-inch screen is not available, a 3/4-inch screen should be selected to be put in the unit. If a 7/16-inch screen is not available, a 3/8-inch screen should be used.

Conveyers

Conveyers (fig. 6-10) are used to move material behg processed from one component to another and [o convey the finished product into bins, trucks, or stockpiles. Rubber belt conveyers are of the fixed or portable type. Fixed conveyers are attached to and area component of the crusher unit. They are similar in design and work on the same principle as do portable conveyers.

Before operating conveyers, check to see that belts are aligned and do not rub on the frame or other parts of the plant, As each conveyer is operated, check to see if the belts are ruining true. If the conveyer belt is running to one side on the head or tail pulley, then tighten the end adjustments on that side until the belt is running in the center of the pulleys. On new assembled conveyers, this procedure must be performed quite often during the first few days until the belt is trained. Even after the head and tail pulleys are set and the belts are ruining centrally over them, a conveyer belt may ride to one side and off the end of the troughing rolls. Should this occur, loosen three or four troughing roll assemblies and slide the ends upward about one-fourth inch on the side to which the belt is climbing. his action forces the belt toward the center of the troughing rolls. The (roughing roll frames have slotted holes to allow for this adjustment. The return roll frames have slotted holes for adjustments and may be adjusted in the same manner as the (roughing rolls.

Make sure all troughing and return rolls are rotating. Rolls can be worn through and belts damaged if the rolls become jammed. The belts should be checked frequently to ensure the fasteners are holding and the belts are not slashed or torn. Operating a conveyer with defective Fasteners or belts is dangerous to personnel operating the plant and could also cause damage to other equipment.

All conveyers are provided with wipers located near the tail pulley on the return run of the belt. Keep the

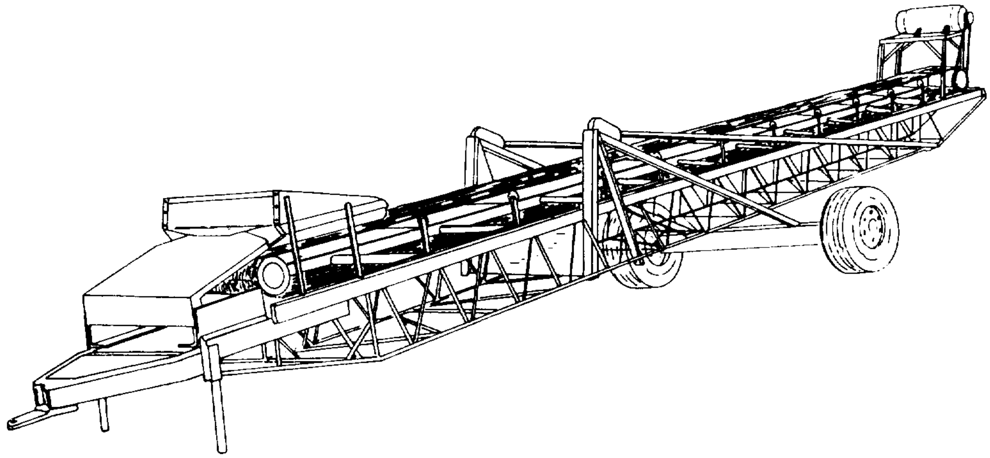


Figure 6-10.-Conveyer.

rubber stripping of the wipers adjusted to just make contact with the face of the belt. This adjustment removes rocks from the belt, thus preventing rocks from entering between the pulley face and inside face of the belt.

Three factors affect the efficiency of conveyer operation. These factors are as follows: speed, loading, and incline.

1. **Speed.** Most conveyers operate at a speed of approximately 300 feet per minute and have a capacity of approximately 300 tons of material per hour. A reduction in speed obviously reduces the conveyer capacity, and an increase in speed theoretically increases the capacity. An increase in conveyer speed may also increase wear on the conveyer belt due to increased slippage of the material at the loading point. An increase in speed also increases the *throw* of the material at the discharge end of the conveyer. In some cases, it may be necessary to fit the end of the conveyer with a box or *bangboard* so the material from the belt falls properly.

2. **Loading.** Proper loading of a belt conveyer is mandatory for efficent operation. This includes placing the load in a position centered on the conveyer belt. A *good practice is to load a conveyer in such a manner that allows the material to strike the belt in the direction of travel.* When material is to be delivered from a spout or belt to another belt from one side, a transfer box or bangboard should be provided to facilitate proper delivery on the belt. Loading a conveyer belt on one side causes it to run to the opposite side of the support rollers which results in excessive belt wear.

3. **Incline.** Portable conveyers can be adjusted to operate at the various inclines required to meet job conditions. The maximum incline is determined by the material carried on the conveyer and varies from 12 degrees for washed gravel to 20 degrees for loose earth. When the maximum angle is exceeded, slippage may occur.

WASH PLANT

In many types of construction operations, it is not necessary to have washed clean aggregates in the finished product; however, some types of operations require clean aggregates free of objectionable material. The wash and screen plant (fig. 6-11) consists of a scrubber, a vibrating screen, and a screw (sand) dehydrator (fig. 6-12). In operation the raw material is fed into a scrubber designed to break loose all deleterious material. The scrubbed aggregate and wash water are cast upon a triple deck vibrating screen for size separation. The materials retained on the decks of the screen are sent by individual chutes to their respective conveyers for further disposition. The wash water and sand are carried through the third deck into the well of the sand dehydrator, where the undesirable products are removed from the sand by the abrasive washing action of the spiral conveyer and carried out into a flume by means of the overflow water. The clean sand is carried up and out of the water and discharged into a stockpiling conveyer.

The capacity of the washing and screening plant is based on the percent of sand in the deposit; for example, each single screw washer can handle a certain amount of material. The screen is also a factor to consider when figuring the capacity of this plant. It is necessary to have enough screening area to handle each gradation of material desired.

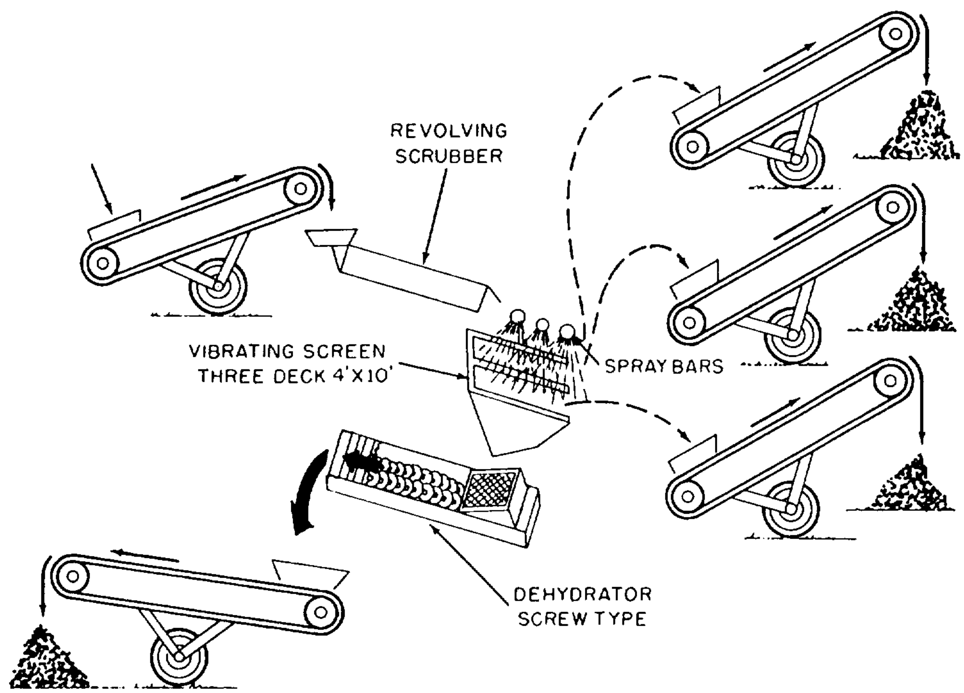


Figure 6-11.—Wash and screen plant.

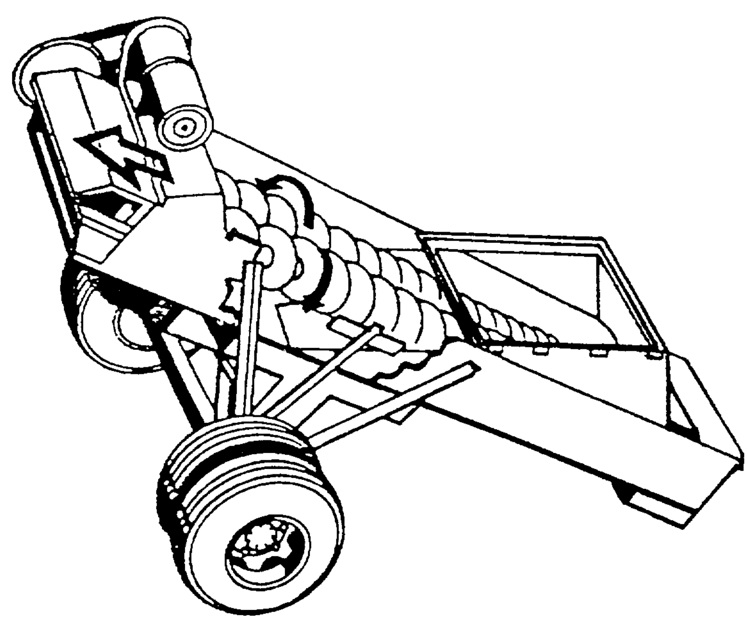


Figure 6-12.—Sand dehydrator.

PLANT LAYOUT

Once the plant is in operation, there is seldom time available to stop operations to remodel; therefore, the layout and erection of the crusher unit should be given adequate time to ensure an efficient facility is built.

Equipment Configuration

Special attention should be given to creating a logical flow of material from the point where trucks enter the plant with raw material to the point where trucks depart from the crusher with crushed aggregate products. You should evaluate the physical environmental requirements of each piece of equipment, such as foundation requirements, water requirements, and power requirements, to ensure they are included during the construction stage.

Drainage

Adequate drainage charnels should be constructed during the initial earthworking stage of construction and constantly improved as the plant is built. This is significant because most of the rock crushing plants have electrical components inherent to their operation.

Prevailing Winds

Equipment should be oriented in such a manner that prevailing winds carry the rock dust generated by the crusher away from the facility. Support equipment, such as generators and water pumps, and permanent facilities, such as latrines, offices, and maintenance shops, should be located out of the path of winds carrying the rock dust.

DO NOT FORGET THE DEPARTMENT OF ENVIRONMENT'AL QUALITY (DEQ) REQUIRE-MENTS FOR DUST CONTROL. The DEQ works for the *Environmental Projection Agency (EPA).* The EPA has established standards for controlling the amount of rock dust that can be admitted into the air.

The *COMSECOND/COMTHIRDNCB Equipment Offices* work closely with the DEQ to ensure the plants in the NCF abide by the rules of the DEQ. Sprinkler systems have been installed on rock crushers in the NCF to control the rock dust produced from crushing operations to meet the requirements of one rule. As the crusher supervisor, you are responsible to make sure these systems remain operational.

Organization of Space

The crusher design should include adequate space around the equipment. This space is required to provide access areas for maintenance personnel to perform repairs, space to move cranes in and out to lift out and replace or rotate worn jaw plates and roll shells, space for the fuel truck to refuel the equipment, and space to remove and replace components of the crusher unit.

Material Handling and Storage

The plant should include adequate material-handling devices to expedite the flow of material through the plant and eliminate double handling of the material.

A headwall ramp should be constructed to allow haul units or loaders to back up to or approach the apron feeder of the primary unit and discharge their loads. If a problem with oversized rock is anticipated, you should have a prescreening grizzly built in the quarry or over the apron feeder to remove the oversized rock.

When possible, store quality product size aggregate in bins, rather than in open stockpiles. This is most important when the aggregate is crushed to specifications sizes or has been washed. Open stockpiling of aggregate can be contaminated by windblown sand, fines, and trash.

When bins are not available for aggregate storage, headwalls should be constructed for stockpiles to ensure separation of different sizes of aggregate being processed. The area separating headwalls should be large enough to stockpile a large supply of aggregate and have adequate space on the front side for loading vehicles without causing congested traffic areas.

Aggregate stockpiles are loaded by loaders or clamshells. These machines are most efficient for loading vehicles with clean aggregate off the top of stockpiles. The aggregates at the bottom of stockpiles become embedded in the ground and tend to become contaminated. This layer is lost for use.

Stockpiling

Stockpiling is most efficiently accomplished on hard, flat, clear areas. The location of the stockpiles should be convenient to the quarry, the crusher, and the hauling unit. When available space is large compared with the bulk of material to be stored, trucks may dump piles as closely as possible to each other.

When packing by trucks does not cause damage to the material, a pile can be smoothed off with a dozer, and one or more additional layers can be added. Factors limiting the maximum height are the slope in from the edges and the gradual grade for the truck ramp. Figure 6-13 illustrates the building of a stockpile by backing trucks upon the ramp and building it up in layers. Ramp grade should not be so steep as to strain the truck or to prevent them from dumping cleanly.

Figure 6-14 illustrates the building of a stockpile by use of a spiral ramp. This is started as a narrow, backup pile that is spread on the outside far enough to protect the ramp from caving in and well past the center on the inside. The ramp, steadily rising, is turned and comes back on the far side, parallel with the first section, but above it. Material is still dumped far enough to the outside and inside to protect the ramp.

When material is too soft or too loose to support trucks, the ramps may be strengthened by the use of wire mats, or small quantities of screening, soil, or other binders if their use will not spoil the value of the stockpile.

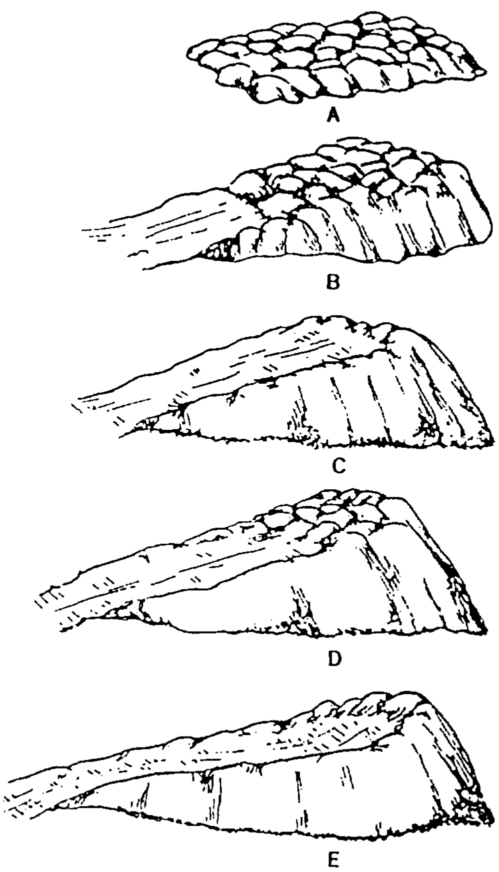


Figure 6-13.-Ramp stockpile.

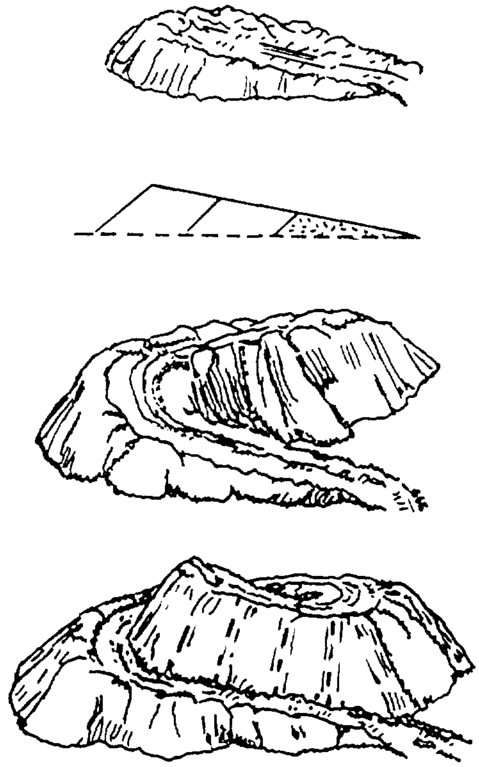


Figure 6-14.-Spiral ramp stockpile.

Trucks may be kept off a stockpile, either for safety measures or to avoid packing, by dumping on level ground and piling by dozer or loader. The loader is more efficient because it can combine lift with push for higher, steeper piles with shorter moves and less power consumption heaping stockpiles rapidly. The dozer is entirely flexible in placing or varying the size and shape of a stockpile and can be used for a variety of other work; however, it must move its entire weight up the pile with each load, and the constantly working tracks on the dozer may be subjected to severe wear in sand or other abrasive materials. Also, the tracks may pack or crush soft materials that drastically reduces their value.

Choice of tracks or wheels depends on the availability of equipment and the type of material. Wheels provide more compaction and cause less breakage into fines. They wear less in sand or gravel as long as the operators avoid spinning the tires during loading operations; however, wheels become ineffective under slippery conditions.

Loaders of either type can be used to reclaim the pile, loading the material into trucks or carrying it to hoppers or to the area of use. Tires have an advantage in both speed and economy for carries greater than 50 feet.

Road Networks

During the plant erection stage, plans should be made for the layout of roads. Well-planned roads are needed to prevent congestion, decrease the time haul units are in the plant, and for safety. Road networks are needed for the following:

1. Haul units bringing rock from the quarry
2. Trucks hauling the product aggregate to construction sites
3. Service vehicles, such as crew, fuel, and maintenance vehicles

If possible, plant roads should be one way and be wide enough for the largest haul unit expected. They should be designed to support heavy loads.

Plant roads must be maintained constantly. In dry areas where there is little rainfall, a water truck is required to wet down the roads to control the dust. In wet areas crushed rock should be used on the roads to keep haul units from sliding off into ditches. A maximum speed limit should be posted for vehicular traffic within the crusher area and on the haul roads.

PLANT ERECTION

The importance of proper site preparation and proper stationing of the plant cannot be overemphasized. Your site for stationing the plant should be flat, level, and well compacted. Crushing and screening plants may be operated for short periods of time from the wheelbase. But it is advantageous on longer and more deliberate jobs, from a maintenance standpoint, not to operate the plant until it has been blocked and leveled with the tires clear of the ground. You should include the following steps in the operational start-up phase:

Operating instructions. All appropriate technical manuals must be reviewed and studied before the beginning of plant operations.

Training. You should train all personnel assigned to operate and maintain the plant. During this training period the importance of site preparation, setup, maintenance, and safety should be emphasized. You should keep the proper tools, materials, and manuals at the site. A high rate of aggregate production should not be expected until personnel become familiar with the equipment.

Tools. The tools used in maintenance and assembl y of the plant are included in the mechanic's tool kit which is part of the NCF TOA. Basic issue items that are incorporated with each plant are also available.

Leveling. The plant should be leveled before initial operation and should be frequently checked while in operation. Leveling should be done on the frame for longitudinal leveling. A rigid, straight plank should be used across the unit frame rails for transverse leveling. The leveling should be checked at several points throughout the unit.

Blocking. Blocks should be installed under each side of the tandem axles and under the dolly axle or the fifth wheel plate to raise the tires or landing gear clear of the ground. Place blocking or cribbing parallel to the longitudinal center line of the unit.

Hydraulic jacks. Jacks should be on each side of the unit opposite each other and under the unit frame members. Raise and lower the jacks in equal increments to prevent bending of the frame.

Screw type of stabilizing jacks. Tighten the screw type of stabilizing jacks to *maximum* torque after the crusher has been blocked and leveled.

Nuts and bolts. Ensure *all bolts are tight by torquing the nuts, not the bolt heads.* Additionally, <u>retorquing should be continued throughout the operation of the plant.</u> This should be performed at critical locations and during the initial operation to assure proper seating and prevent parts from loosening and getting out of adjustment. Any adjustments required, such as movement of trunnion wheels on the trunnion shaft, should be made during the first hours of operation.

Jaw plates and roll shells are held in place by wedges which are secured by keeper bolts. The wedges must be driven *home* with a sledge hammer while constantly applying torque with the wrench to achieve proper tightening.

Visual inspection. To prevent damage and eventual breakage, you should visually inspect the plant constantly to detect any misadjustment or loss of adjustment. Visual inspections should be made from ground level, from the platform, and from walkways. All adjustments should be checked with the components operating while empty and rechecked while loaded with aggregate.

75-tph Plant

The 75-ton-per-hour plant is used in any of four basic setups, depending upon the raw material available and the nature of end products required for construction projects. The four basic setups are as follows:

1. The jaw crusher is used alone to work with quarry rock. Large quantities of material are ordinarily needed for base course, roads, and airfields; the fine particles are desired for binder. This means all of the crushed material is used together with no screening necessary.

2. The primary and secondary units are used in conjunction with each other to produce graded aggregate from quarry rock. The material is reduced in successive stages and screened to separate material into size ranges required to meet specifications.

3. The primary and secondary units are used together to produce graded aggregate from gravel deposits which are too large in size to be handled by the secondary unit alone.

4. The secondary unit is used alone when the bulk of material in a gravel deposit does not exceed 3 inches in diameter. In this case, a positive means is provided to limit the size of material fed to the unit.

Rarely are two aggregate production operations exactly the same. Each project must be analyzed on the basis of its own particular conditions and requirements. The 75-tph plant equipment is sufficiently flexible to meet all aggregate requirements of construction battalions.

Maintaining Quarry Equipment

Because of the working conditions around a crushing operation, the entire crew must be totally familiar with the manufacturer's requirements and any special conditions that may exist. This ensures proper maintenance and the safe and productive operation of the crusher equipment.

The entire quarry and rock production operation depends on proper and adequate maintenance of equipment. A regulated program of maintenance, including step-by-step procedures, is recommended for each piece of equipment.

In contrast to other types of construction equipment, procurement of repair parts and new units for crushing and screening equipment requires a much greater lead time. Without proper parts and units, production either slows down or stops altogether.

As the supervisor in charge of crushing and screening operations, you must ensure operator maintenance procedures are performed by the operators and maintenance mechanics to ensure continuous operation of the equipment.

WARNING

Be sure the main power sources remains “OFF” and are properly “red-tagged” while personnel are working on electrical equipment.

Frequent inspections should be made during operations to ensure that the equipment is not being abused, that the units are level and cribbed, that calibrations are correct, and that proper shutdown procedures are followed.